



LIFE IN WATER

Benthic Invertebrate Response to Restoration Activities in Paradise Creek, Moscow, Idaho From 1994-2014

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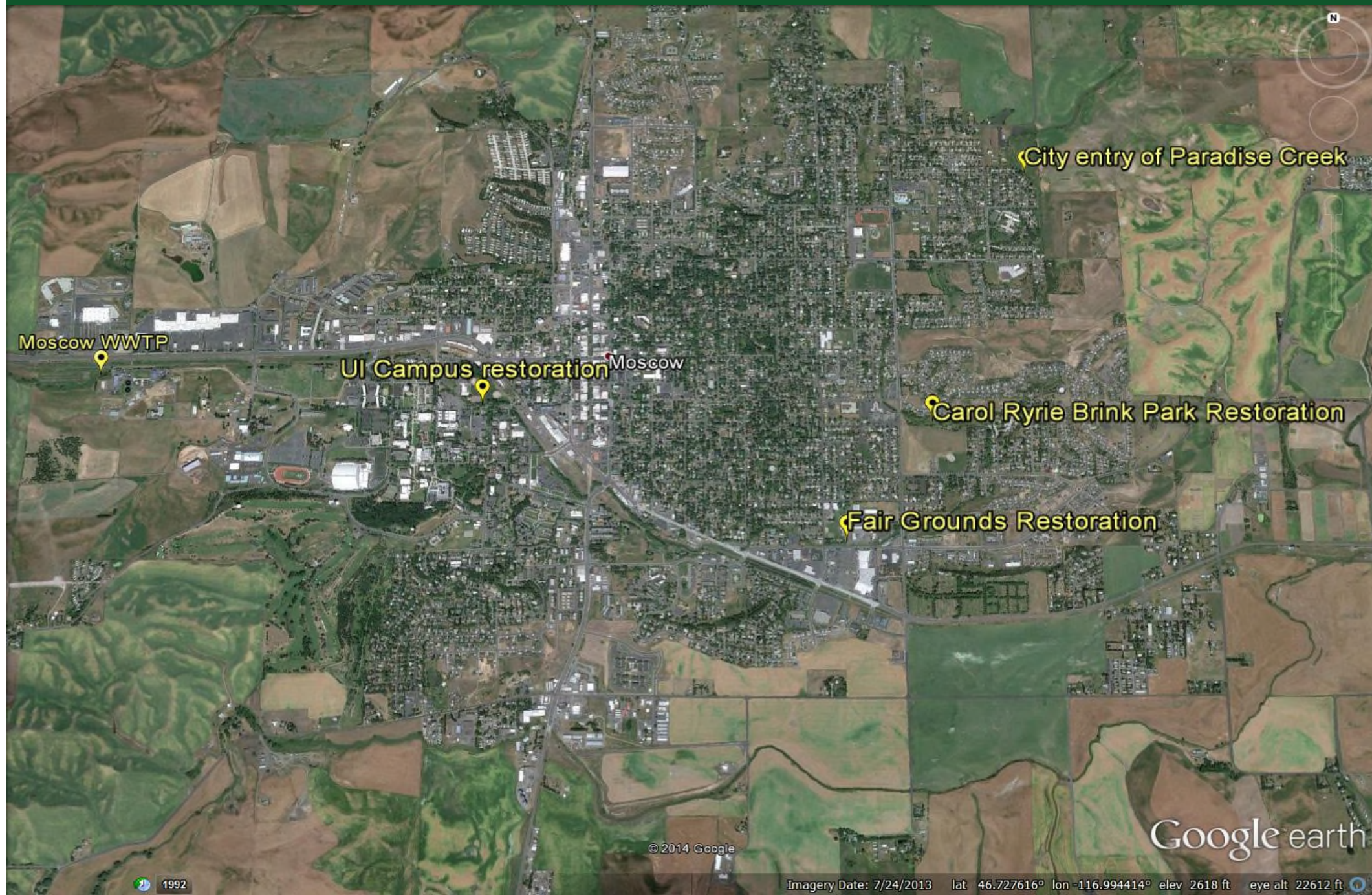
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FRESHWATER • ESTUARINE • MARINE

Study Area



Study Area



Headwaters

4 km forested headwaters



Upstream Agricultural Range

10 km dryland agricultural



City Entrance - Upstream

BUFFERS? WE DON'T NEED NO STINKING BUFFERS!



City Entrance – Downstream View



Above Carol Brink Restoration



Below Brink



Moscow WWTP



Paradise Cr. at WWTP



Regulatory Context

- Paradise Creek is categorized as a cold-water stream, yet dissolved oxygen drops well below the 6.0ppm criterion for coldwater streams.
- INTERMITTENT flow upstream from WWTP discharge.
- The 1999 TMDL process identified a target of 75% reduction in sediment and 59% phosphorous from non-point sources; targeted 98% reduction of phosphorous and 80% ammonia from City of Moscow WWTP; cooling stream temperature from 23 to WADOE 1999 standard of 18 degrees C.

Introduction

- Since the mid-1990's IDEQ has sporadically collected BURP data at several sites in the watershed.
- During that time frame there have been approximately **\$1.5million** in restoration activities implemented within the Moscow city limits.
- Also, the Moscow WWTP expended approximately **\$25million** in upgrades in 2002 and 2010.

City of Moscow WWTP

- Trickle filters 1938-2002
- **UPGRADE** to advanced secondary biological nutrient removal in 2002
- **UPGRADE** to tertiary filtration in 2010: Parkson DynaSand filters (5)
- **Average 2mgd flow; 4mgd capacity**
- **100% Ammonia removal**
- **99% removal BOD, total P, TSS**

Summertime Flows

August Paradise Creek flow: 0.10 - 0.35cfs

August WWTP flow: 0.33 - 1.91cfs

Study Objective

Analyze benthic macroinvertebrate communities in Paradise Creek (1995-2014) in relation to WWTP upgrades and a physical habitat restoration project.

Sampling Sites by Year

(21 sampling events 1994-2014)

Table 1. Paradise Creek Sampling Sites

Headwaters, Idlers Rest, 1998
City Entry (Mountain View Park), 2002
City Entry (Mountain View Park), 2013
Upstream of Carol Brink Park restoration, 2013
Upstream of Carol Brink Park restoration, rep. 1-4, 2014
Carol Brink Park restoration, 1994
Carol Brink Park restoration, 1995
Carol Brink Park restoration, 1996
Carol Brink Park restoration, 2012
Carol Brink Park restoration, 2013
Carol Brink Park restoration, rep. 1-4 2014
Downstream of Carol Brink Park restoration, 2013
Downstream of Carol Brink Park restoration, rep. 1-4, 2014
Hérons Hideout restoration, 2013
Fair Grounds/Fire House restoration, 2013
UI Campus restoration, 2006
UI Campus restoration, 2013
Near the Moscow WWTP, 1998
Near the Moscow WWTP, 2002
WWTP outfall and location of new plant, 2010
Near the Moscow WWTP, 2013

Field and Lab Methods

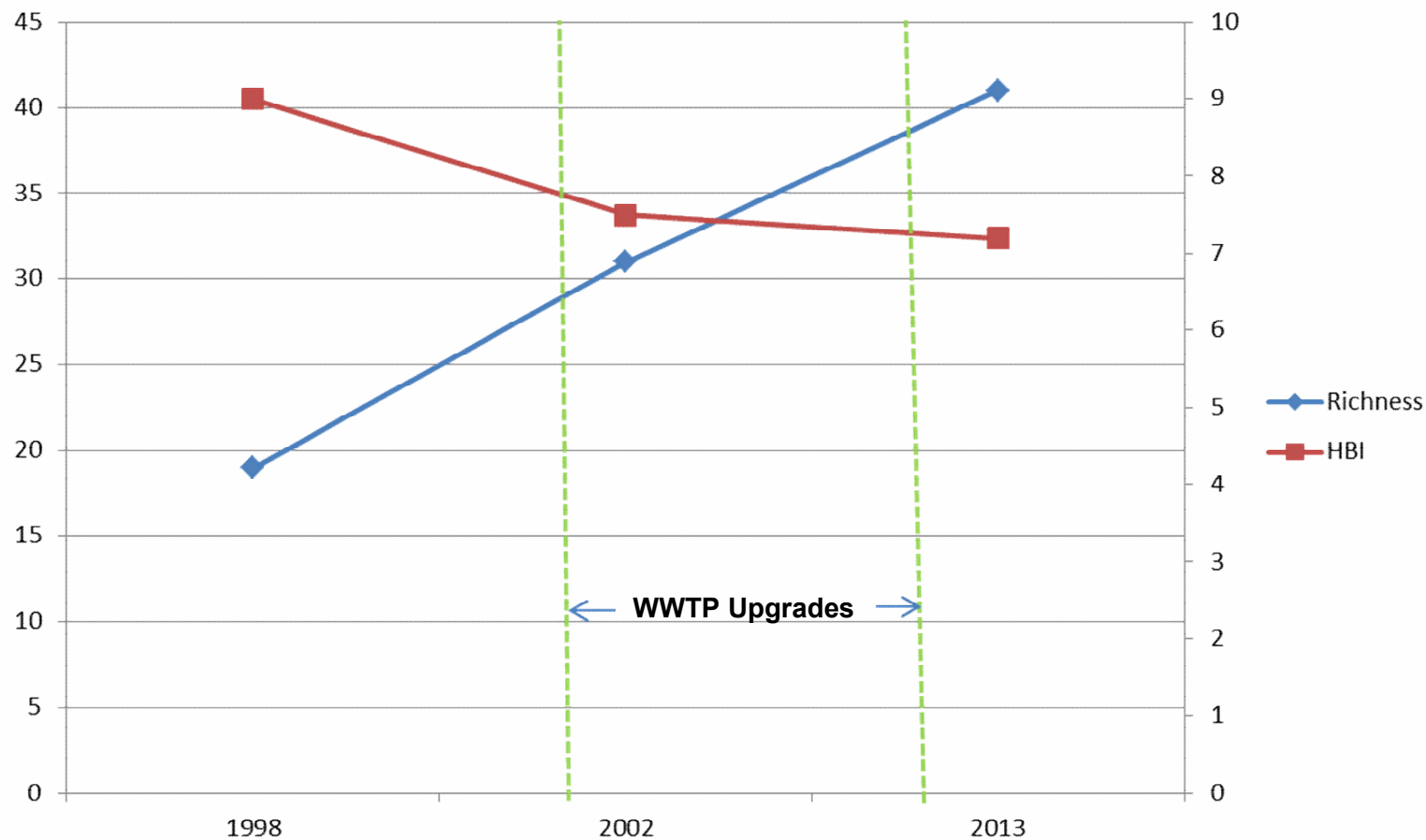
- Hess sample from 3 flowing areas – field composite
- 500 organisms subsample
- 500 micron mesh
- Currently ID to genus species, including midges/worms

Methods

Simple comparison of taxa lists, taxa richness and tolerance values (HBI) to look for differences between sites/years.

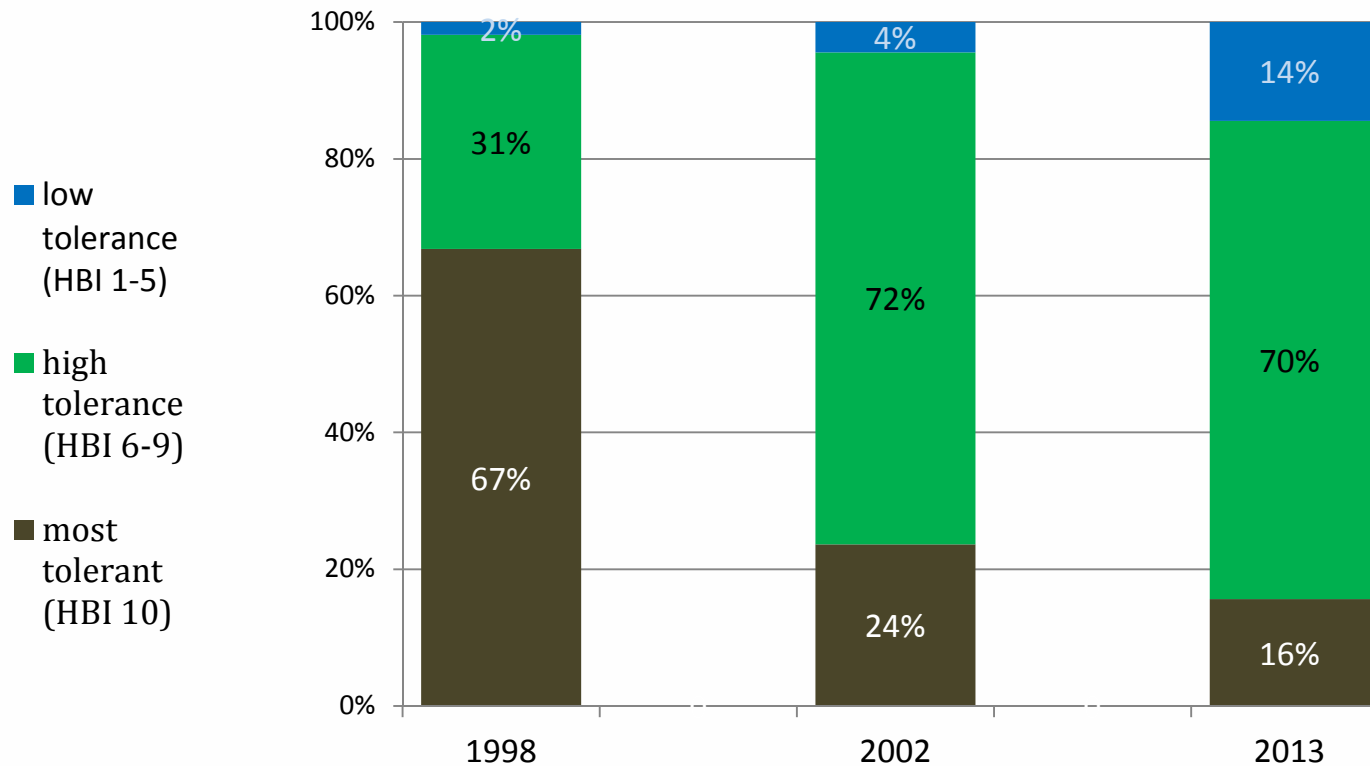
BMI Results – WWTP Upgrades

Richness and HBI Below WWTP After Upgrades



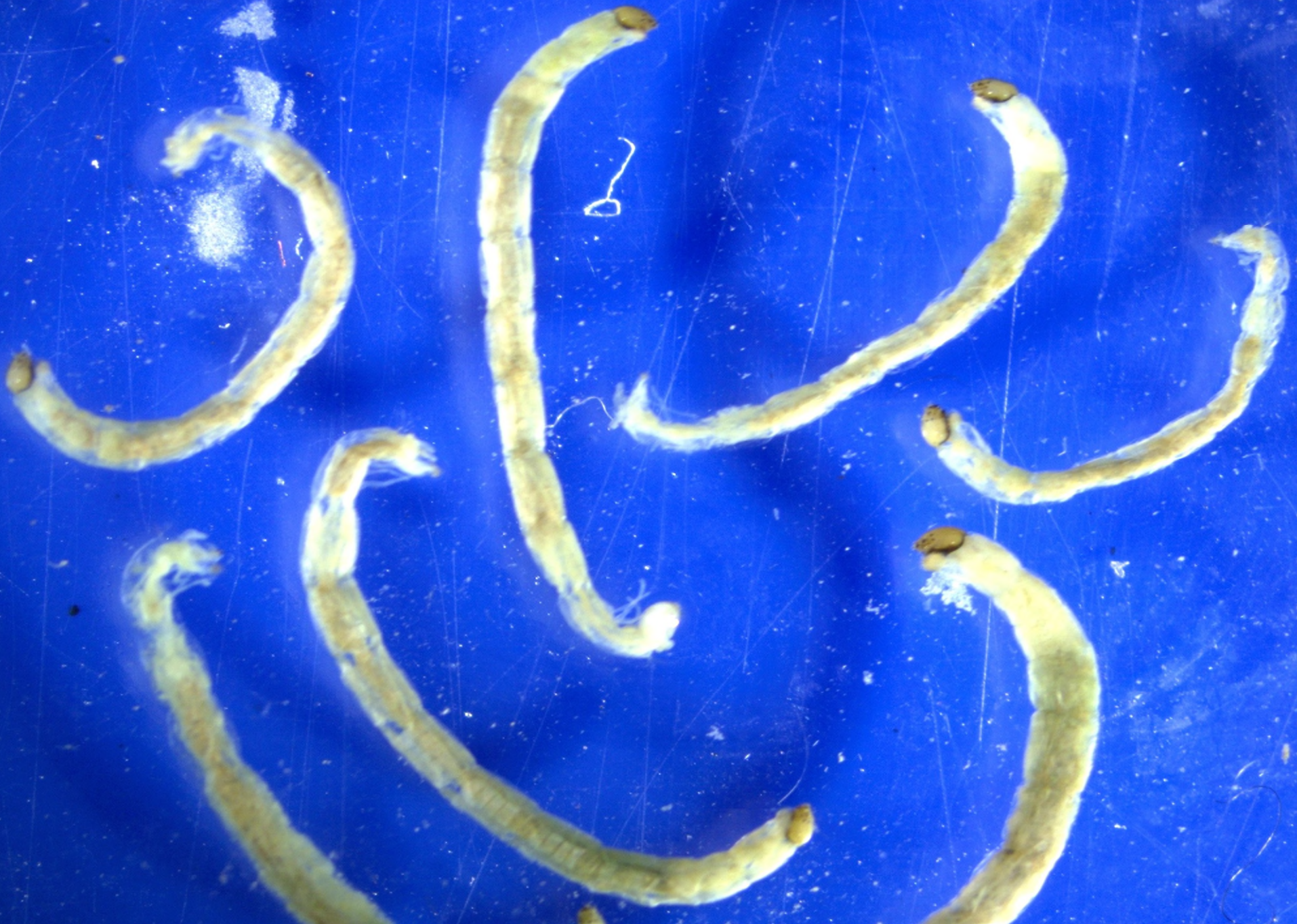
Results

Pollution Tolerance Composition before and after upgrades at Moscow WWTP

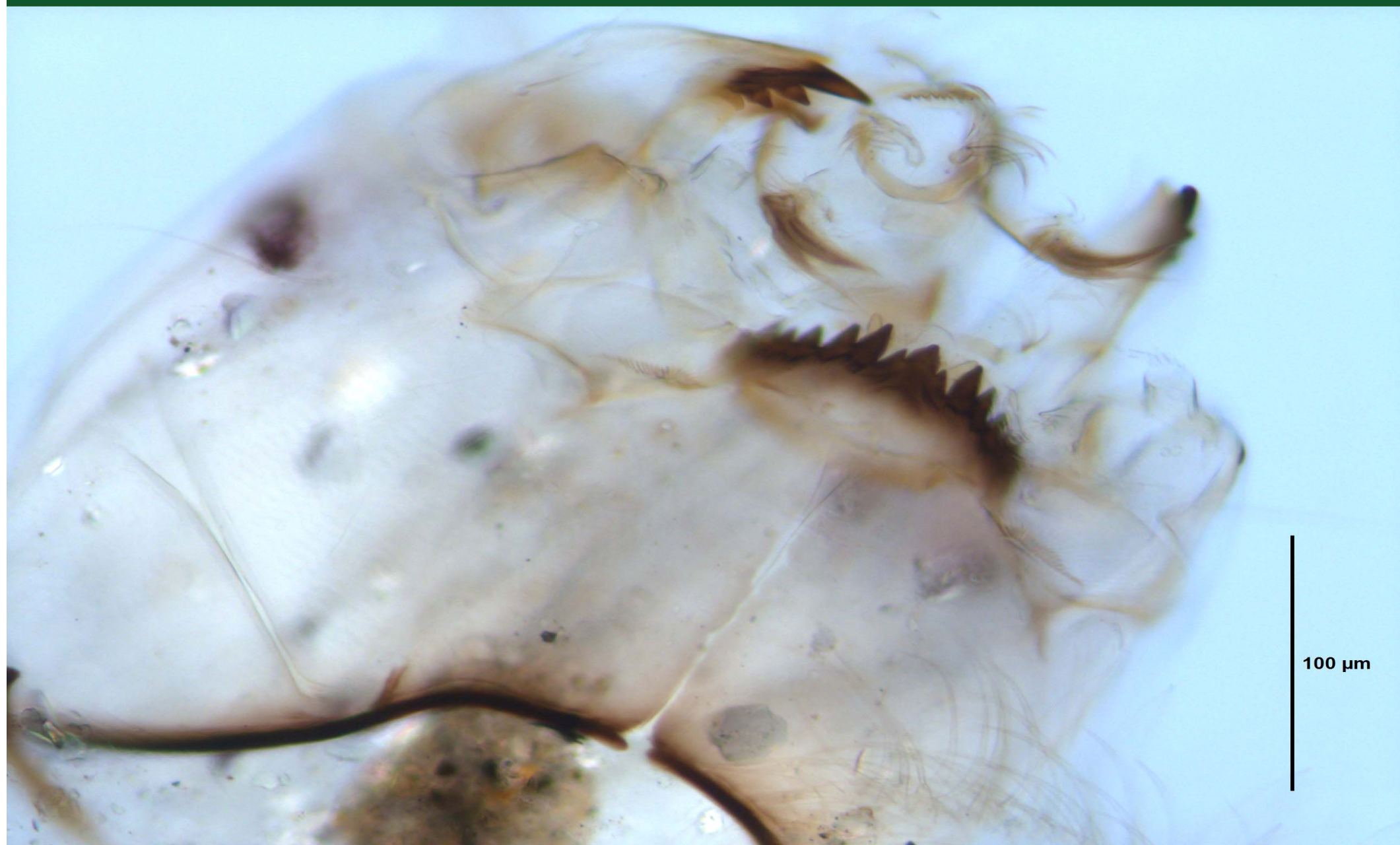


Moscow WWTP was completely replaced in 2002 with a Biological Nutrient Removal (BNR) process and effluent filters were added in 2010 to remove phosphorus.

Dominant Taxon: Bloodworms



Dominant Taxon: Bloodworms



“Sensitive” Caddisflies



Habitat Restoration: Carol Ryrie Brink Park



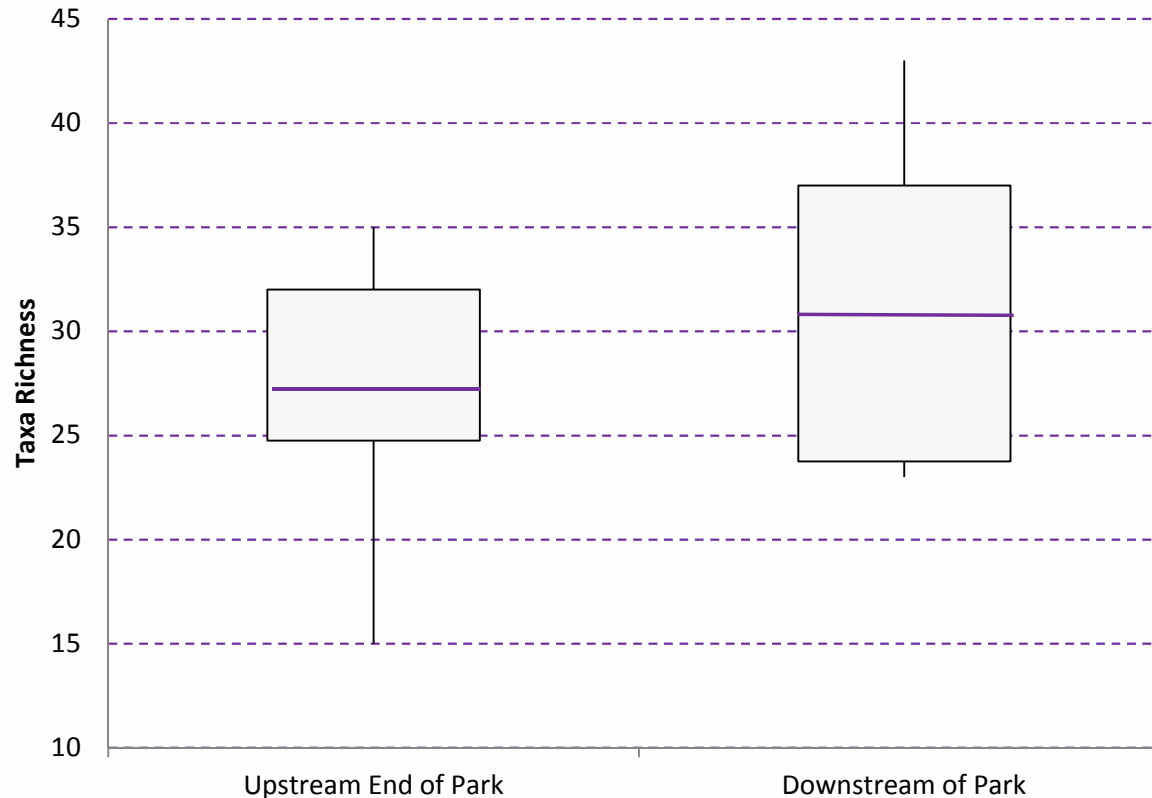
370m Long Restoration Site - 1995



Below Brink

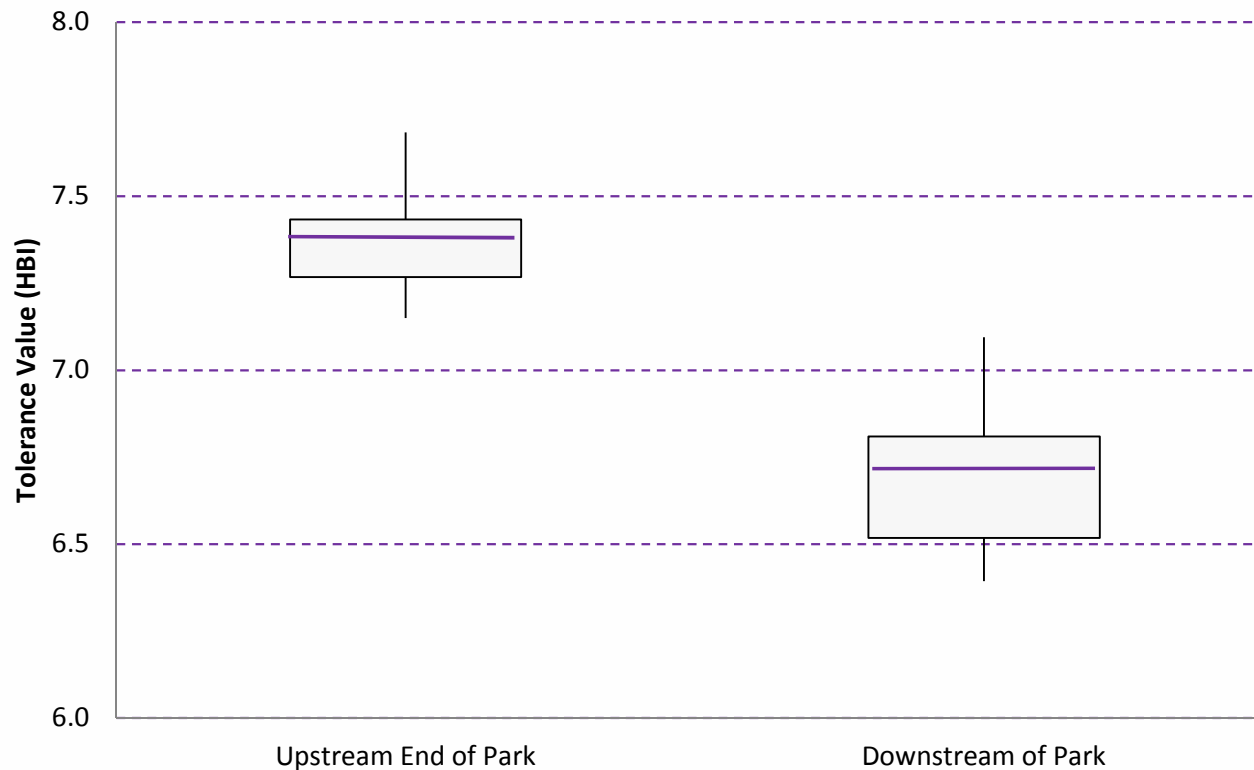


Taxa Richness - Habitat Project



Box Plots for four 2014 replicates, displaying the range, quartiles, and average of the number of different taxa collected at Carol Ryrie Brink Park. Increased taxa richness is generally considered an indicator of improved conditions.

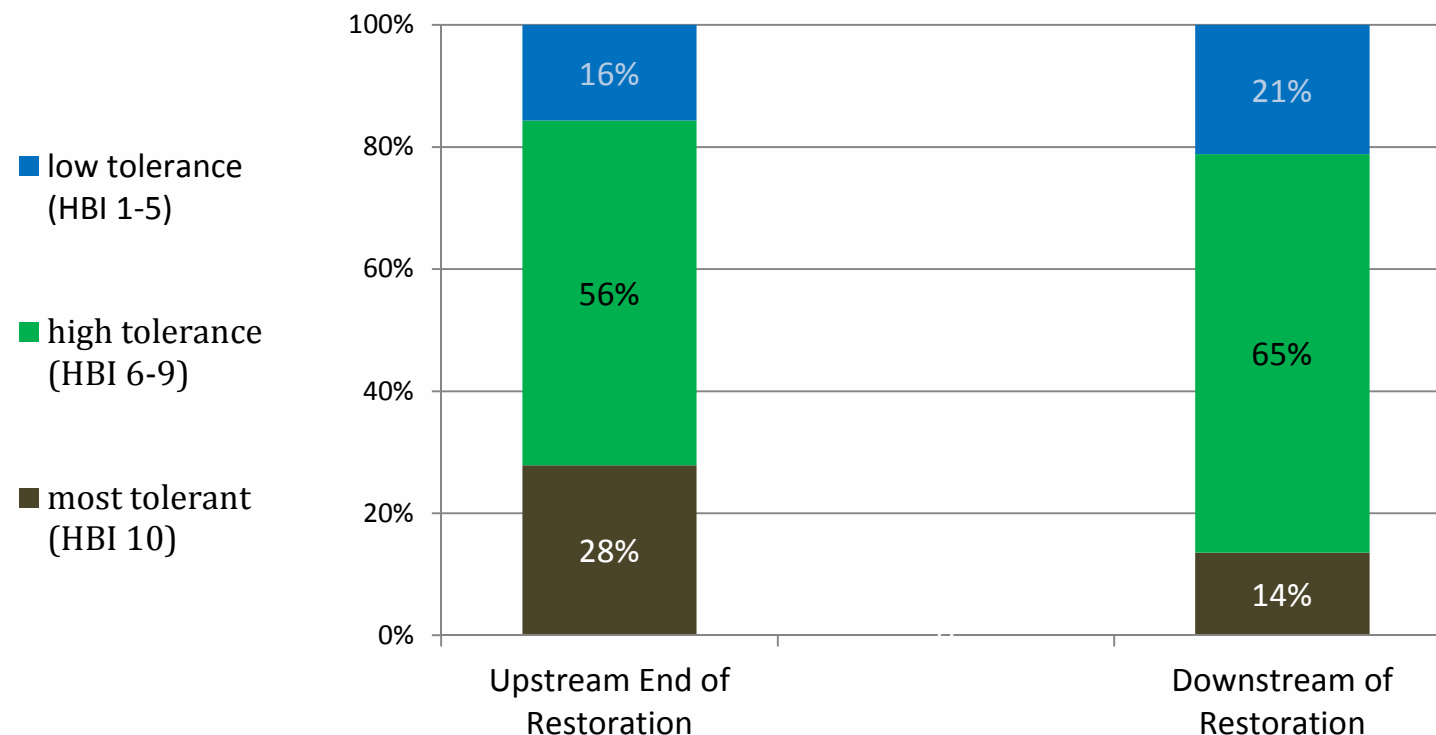
HBI Score - Habitat Project



Box Plots for four 2014 replicates, displaying the range, quartiles, and average of the Hilsenhoff Biotic Index tolerance values collected at Carol Ryrie Brink Park. Decrease in this metric demonstrates an invertebrate assemblage less tolerant of pollution.

Results

Pollution Tolerance Composition in 2014 at Carol Ryrie Brink Park Restoration
(from combined data of 4 replicates each)

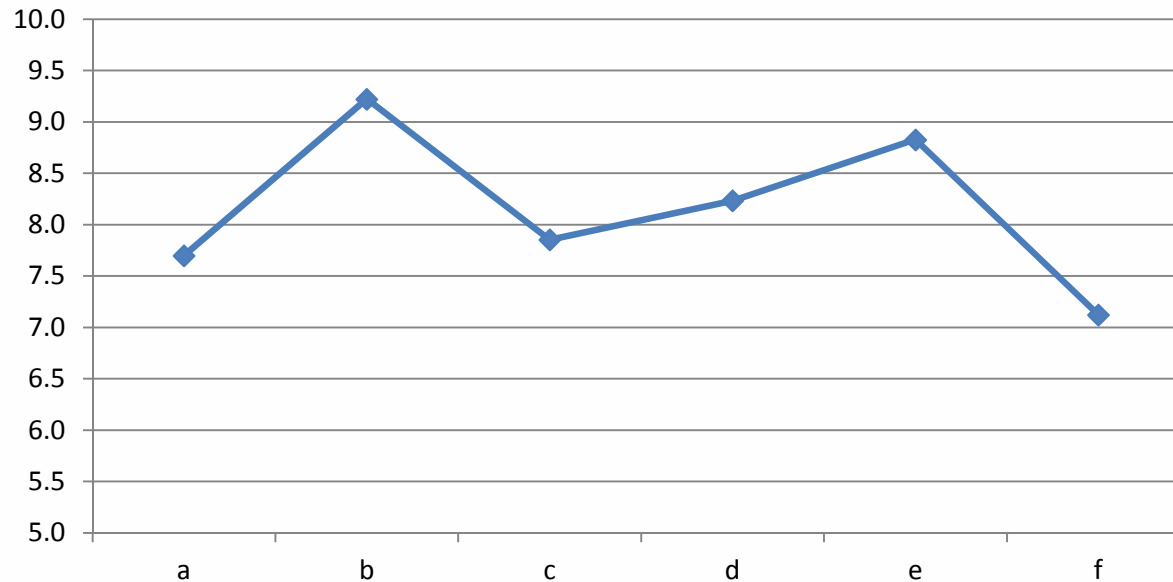


Considerable restoration since the mid-1990's occurred throughout the **370 meter reach** of Paradise Creek at Carol Ryrie Brink Nature Park.

Results

2013 Longitudinal Changes in Moscow

Weighted average HBI Tolerance Value



- a - City Entry (Mountain View Park)
- b - Upstream end of Carol Brink Park Restoration
- c - Downstream of Carol Brink Park Restoration
- d - Fair Grounds/Fire House Restoration
- e - UI Campus Restoration
- f - Near the Moscow WWTP

Discussion – Challenges We Faced

- There was no long term macroinvertebrate study plan in place to monitor the biological effects of restoration activities. As a result, we could not make statistical inferences regarding change. BACI design would have been very helpful.
- Paradise Creek is a soft-bottom stream that is dominated by midges, worms, etc. Early BURP taxonomy protocols left midges at family and worms at class, but in later years these were all identified to genus/species. If we rolled everything up to family and class we would have nothing to work with. Therefore, we were not able to use the mid-1990's data.

Discussion – WWTP Upgrade Effects

- The WWTP provides more stable flow into the creek, providing better overall habitat condition downstream.
- Reduction in P and ammonia have resulted in higher quality effluent flowing into the creek.
- As a result, overall community tolerance has improved and taxa diversity has increased.
- In this study the best benthic community is located downstream from the WWTP.

Discussion – Brink Restoration Effects

- The extensive restoration at Carol Ryrie Brink Park may have had some positive influence on the benthic invertebrate community.
- While still dominated by midges, total taxa richness increased slightly.
- Some of the most tolerant taxa were reduced in abundance and replaced by less tolerant taxa.
- TAKE A LONG TERM VIEW ON HABITAT WORK!

Acknowledgements

- John Cardwell, IDEQ - Lewiston for funding and providing the impetus for this study.
- IDEQ field crew members and EcoAnalysts staff who contributed to the field and lab data in the BURP database.

THE END

QUESTIONS, COMMENTS, SUGGESTIONS?

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